

AIR FORCE MATERIEL COMMAND  
**LEADING  
EDGE**

September 2000



**Space Technology**  
**AFMC's quest into space**

# LEADING EDGE

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**Gen. Lester Lyles**

Director of Public Affairs  
and editor-in-chief  
**Col. Donna Pastor**

Chief, Internal Communications  
**Capt. Michael Kelly**

Executive editor  
**Ms. Libby VanHook**

Managing editor  
**1st Lt. CK Keegan**

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## Cover Stories



*The Air Force, along with NASA, is striving to develop a less expensive space program. The X-33 is designed with a faster turn-around launch time, fewer people needed for operation, thus reducing costs. (Artwork courtesy of NASA, cover by 1st Lt. CK Keegan)*

### 4 - 17 Space Technology

*In the 17th Century, telescopes gave astronomers a new look at the heavens. Since then, man's fascination with the stars has grown and so has the desire to reach into space and learn its secrets. It wasn't until 1957, when the Soviet Union launched Sputnik 1, that advancements in technology gave us the methods to begin traveling out of Earth's gravity. But it also gave man the realization that space travel is possible, feeding the imagination of both young and old. AFMC is on the leading edge of this quest to explore space. Hold on to your seat, buckle up and get ready for the blast off to space...*

## Mission Progress



**19** *Innovation saves F-22 program \$330,000*

**20** *The same forces which formed the Grand Canyon are at work in Georgia*

**20** *Explosive charges shoot aircraft out of harms way*

## Features

**22** *Tinker gears up to meet demands*

**23** *New museum is "keepin' it fresh"*

## Departments

**3** *Mission Briefs*

**18** *News Briefs*

**24** *Focus on People*

**26** *Awards*

### Back cover

*The Titan IV is one of the space systems managed by AFMC. (Photo courtesy of Lockheed Martin. Illustration by 1st Lt. CK Keegan)*



## TEST AND EVALUATION

### New communication system field tested

ROME, N.Y.— Amidst the treeless, brush and boulder-strewn terrain of the Air Force's Mountain Home Air Force Base Test Range, the military's next-generation tactical communications relay system successfully completed its first operational test in July.

An advanced development model of the Airborne Communications Relay, or ACR, was demonstrated during normal Air Expeditionary Force operational training.

This is a joint program between Air Force Research Laboratory and the Command and Control, C2, Battlelab at Hurlburt Field, Fla.

The system, operating onboard a KC-135 tanker, allowed Air Force tactical air control party units from Fort Lewis, Wash., to extend the line-of-sight of their VHF and UHF radios.

In addition, they were able to establish communications with Arizona Air National Guard F-16 aircraft performing close air support missions at much greater distances than normal, allowing more time to provide precise targeting information to the pilots.

"This technology may be a key

enabler allowing the Air Force to retire the airborne battlefield command and control center aircraft, saving approximately \$10 million a year," said Capt. John MacPherson, program manager in the directorate's information grid division.

— Reported by Mr. Francis Crumb, AFRL Public Affairs

### F-22 successfully fires AIM-9 missile

EDWARDS AIR FORCE BASE, Calif. — The F-22 program met a major test milestone July 25, when Raptor 02 successfully launched an AIM-9 missile over test ranges at China Lake Naval Air Station, Calif.

The test, which took place as the F-22 flew at 20,000 feet, evaluated the next-generation fighter's ability to successfully fire an air-to-air missile from an internal weapons bay.

It is the partial completion of a major milestone the F-22 Combined Test Force is tasked with meeting this year. An AIM-120 missile is scheduled to be fired this fall.

Such tests are crucial because the relationship between aerodynamic forces existing between the airframe and missile must be evaluated to ensure

launches can be done safely.

— Reported by Mr. John Haire, AFTC Public Affairs

## RESEARCH AND DEVELOPMENT

### Arnold analyzes UCAV's wind tunnel data

ARNOLD AIR FORCE BASE, Tenn. — Wind tunnel data obtained here is preparing the Unmanned Combat Air Vehicle for upcoming flight tests and its mission to suppress enemy air defenses and conduct strike missions in high-threat areas.

The system is a joint effort between the Defense Advanced Research Projects Agency and the Air Force, who selected the advanced research and development unit of the Boeing Company's, Phantom Works to design and construct two demonstrator vehicles and conduct flight tests.

"The data will be used to help our program so we can do a better job predicting weapons behavior," said Mr. Mark Pinney, Air Force Research Laboratory integrated process team member for weapons integration. He said the tests will also support the weapons development at Eglin Air Force Base, Fla., and in AFRL."

— AEDC Public Affairs report

## TEST AND EVALUATION

### Laser project takes aim at improving imagery

KIRTLAND AIR FORCE BASE, N.M. — Officials from the Air Force Research Laboratory and the Association of Universities for Research and Astronomy Inc., signed a cooperative research and development agreement July 17. Under the agreement, the laboratory's directed energy director-

ate and the association will work on a laser that, in part, will improve the clarity of objects seen in space.

This laser is being designed to fire into the mesospheric layer, about 60 miles above the earth, to strike a layer of sodium atoms and cause them to fluoresce, or light up, becoming an

artificial star. Some of the light from this star returns to the earth like a beacon. When used with adaptive optics systems on telescopes at the directorate's Starfire Optical Range, scientists are

able to correct for distortions caused by the atmosphere.

"Adaptive optics technology is revolutionizing both satellite imaging and ground-based optical astronomy by greatly improving the resolution," said Dr. John Telle, a development program manager.

The directorate will initially benefit from the agreement in that the association will contribute \$40,000. Scientists from both organizations will work together during the next 24 months to build the laser.

The Starfire Optical Range facility is capable of tracking low-earth orbiting satellites. Its 3.5-meter diameter primary mirror is protected by a unique retracting cylindrical enclosure that allows it to operate in the open air.

— AFRL Public Affairs report

*A laser beam streaks toward a distant star from the Starfire Optical Range.*





# Cover stories



**Oct. 4, 1957** — Soviet Union launches Sputnik 1, the first man-made object to orbit the Earth. It remains in orbit for three months.

**Nov. 3, 1957** — Soviet Union launches Sputnik 2 and with it, a dog, Laika, to investigate how the dog adapts to space. The dog had to be put to sleep after seven days because there were no safe landings at the time.

**Jan. 31, 1958** — The first U.S. satellite, Explorer 1, is launched from Cape Canaveral, Fla. It carries a scientific experiment that discovers the Earth's radiation belt.

**Oct. 1, 1958** — NASA is founded, replacing the National Advisory Committee on Aeronautics.

**Sept. 12, 1959** — Soviet Union launches Luna 2, which carries a copy of the Soviet coat of arms and becomes the first man-made object to hit the moon.

**April 1, 1960** — United States launches the first successful weather satellite, Tiros 1.

**Aug. 18, 1960** — First spy satellite, Corona, is launched by the U.S. Air Force's Discoverer XIV.

**April 12, 1961** — Yuri Gagarin, Russian cosmonaut, is the first man in space aboard Vostok 1. He orbits the Earth once.

**May 5, 1961** — Alan B. Shepard, Jr., is the first U.S. astronaut in space, in a suborbital flight. He flies on Mercury Freedom 7.

**Feb. 20, 1962** — Mercury Friendship 4 lifts off with John Glenn, Jr., the first American in orbit.

**July 10, 1962** — The U.S. satellite Telstar 1 relays the first live transatlantic telecast.

**Dec. 14, 1962** — United States has the first successful planetary spacecraft, Mariner 2, which flies by Venus and enters a solar orbit around it.

**June 16, 1963** — Valentina Tereshkova, the first woman in space, travels on Vostok 6 around the Earth 48 times.

**March 18, 1965** — The first space walk is made from the Soviet Voskhod 2 by Alexei Leonov.

**June 13, 1965** — Edward White II makes the first U.S. space walk from Gemini 4.

**Feb. 3, 1966** — The Soviet Luna 9 becomes the first spacecraft to soft-land on the moon.

**April 23, 1967** — Soviet Union launches Vladimir Komarov in Soyuz 1. It crashed the next day, killing Komarov making him the first space-flight fatality.

**Dec. 21, 1968** — Apollo 8 becomes the first manned spacecraft to orbit the moon. It carried Frank Borman, James Lovell Jr. and William Anders.

**Jan. 20, 1969** — American astronauts Neil Armstrong and Edwin Aldrin Jr. make the first manned soft landing on the moon aboard Apollo 11, as well as the first moon walk.

**April 11, 1970** — Apollo 13 is launched. Its moon landing is aborted after an oxygen tank explodes. The crew, James Lovell Jr., John Swigert Jr. and Fred Haise Jr., return safely.

**Nov. 17, 1970** — Luna 17, from the Soviet Union, lands on the moon with the first automatic robot, Lunokhod. A five-man team controlled its movements from Earth.

**Sept. 29, 1977** — The Soviet Union's Salyut 6 space station is launched. Its crew includes members from Czechoslovakia, Poland, German Democratic Republic, Bulgaria, Hungary, Vietnam, Cuba, Mongolia and Romania.

**May 13, 1982** — Soviet cosmonauts Anatoli Berezovoi and Valentin Lebedev rendezvous with the Salyut 7 space station, becoming the first team to inhabit the space station.

**June 19, 1983** — Sally Ride becomes

the first American woman to travel in space on the space shuttle Challenger.

**Feb. 3, 1984** — Bruce McCandless takes the first space walk without a tether on the Challenger.

**Jan. 8, 1985** — Japan's Institute of Space and Aeronautical Science launches the Sakigake probe. It became the first interplanetary probe when it rendezvoused with Halley's Comet.

**Jan. 28, 1986** — Space shuttle Challenger explodes shortly after liftoff. The entire crew is killed.

**May 1988** — The Air Force chooses General Dynamics to develop the Atlas II. The Atlas was fielded as an Inter-Continental Ballistic Missile in the 1960s and was used in all three unmanned lunar explorations.

**April 24, 1990** — Space shuttle Discovery deploys Edwin Hubble space telescope astronomical observatory.

**June 5, 1991** — Space shuttle Columbia carries Spacelab SLS 1 into orbit to investigate the effects of weightlessness on humans.

**Feb. 1994** — Sergei Krikalev, Russian cosmonaut, flies on space shuttle Discovery in the first joint United States and Russian space shuttle mission.

**Aug. 29, 1996** — Canada launches the Ultra-Violet Auroral Imager instrument aboard the Russian Interball-2 spacecraft. The project had been postponed several times over nine years because of budgetary problems caused by the collapse of the former Soviet Union.

**November 1996** — Initial phase of the Evolved Expendable Launch Vehicle completed.

**July 4, 1997** — The Mars Pathfinder arrives at Mars to photograph the planet. The data collected encourages scientists to believe the planet may once have harbored life. The planet is more like Earth than previously suspected.

**Jan. 6, 1998** — NASA launches the Lunar Prospector spacecraft to survey the moon's surface. It returns data which suggests there are anywhere from one billion to ten billion tons of ice crystals in the moon's polar craters, increasing possibilities for future colonization.

**Oct. 29, 1998** — American astronaut John Glenn, 77 years old, returns to space aboard Space Shuttle Discovery as part of a study on the effects of space travel on the human body and the aging process.

**Feb. 18, 1999** — The U.S. Voyager 1 spacecraft passes Pioneer 10 to become the man-made object to travel

the furthest from the Earth. It carries recorded sounds of a mother's kiss and greetings in 55 languages.

**May 27, 1999** — Space shuttle Discovery docks with the International Space Station.

**July 25, 2000** — Zvezda, a new space home, docked with the International

Space Station, opening the way for the first crew to move in later this year.

**July 27, 2000** — In 2003, NASA plans to launch a relative of the 1997 Mars Pathfinder rover. Using drop, bounce, and roll technology, it is expected to reach the surface January, 2004, and begin the longest journey of scientific exploration ever undertaken on Mars.

## Space systems acquired or managed by AFMC



**Milstar Satellite Communications System** — Milstar is a joint service satellite communication system that provides worldwide secure, jam resistant and low probability of detection, nuclear-event resistant communications for all forces across the spectrum of conflict. The multi-satellite constellation will link command authorities with a wide variety of resources, including ships, submarines, aircraft, land vehicles and manned-portable systems. The satellite actually processes communication signals and can link with other Milstar satellites through crosslinks, therefore, the requirement for ground controlled switching is significantly reduced.

**Defense Satellite Communications System** — Ten Phase III DSCS satellites orbit the Earth at an altitude of more than 22,000 miles. The system is used for high priority command and control communications such as the exchange of wartime information between defense officials and battlefield commanders. The military also uses DSCS to transmit space operations and early warning data to various systems and users.

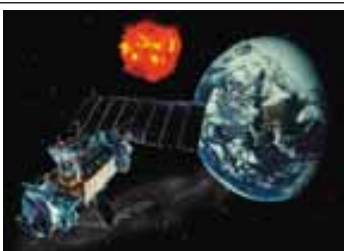
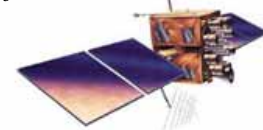


**Atlas IIA** — The Atlas IIA is a two-and-a-half stage vehicle, primarily used to support the Defense Satellite Communications System III program. The Atlas IIA is capable of lifting approximately 14,500 pounds into low-earth orbit and 6,100 pounds to a geosynchronous orbit.



**Defense Support Program Satellites** — DSP satellites help protect the United States and its allies by detecting missile launches, space launches and nuclear detonations. In 1995, a new means of processing DSP data called Attack and Launch Early Reporting to Theater was brought on line. It provides improved warning of attack by short-range missiles against U.S. and allied forces overseas.

**NAVSTAR Global Positioning System** — GPS is a space-based constellation of orbiting satellites that provides navigation data to military and civilian users all over the world. GPS satellites orbit the Earth every 12 hours, emitting continuous navigation signals. With the proper equipment, users can receive these signals to calculate time, location and velocity. The signals are so accurate, time can be figured to within a millionth of a second, velocity within a fraction of a mile per hour and location to within 100 feet.



The Defense Meteorological Satellite Program, or DMSP, designs, builds, launches, and maintains several near polar orbiting, sun-synchronous satellites. DMSP satellites are in a near polar, sun-synchronous orbit. Each satellite crosses any point on the earth up to two times a day and has an orbital period of about 101 minutes, thus providing nearly complete global coverage of clouds every six hours. Each DMSP satellite monitors the atmospheric, oceanographic and solar-geophysical environment of the Earth.

# DSP provides early detection of nuclear explosions

The nation will continue using the Air Force Defense Support Program satellites to warn of missile launches and nuclear explosions.

"The DSP satellites have been a key part of early warning systems since 1971," said Col. Daniel Burkett II, Space Based Infrared System program director.

"Significant improvements have paved the way for many years of global missile warning and defense in the new millennium," he said.

In their geosynchronous orbits, DSP satellites help protect the United States and its allies by detecting ballistic missile launches, space launches, nuclear detonations and other infrared-observable events of interest. DSP satellites use infrared sensors to detect heat from missile and booster plumes against the earth's background.

During the last 29 years there have been 19 satellite launches with five major design changes. The DSP has five more satellites to be launched by 2003 for a total of 23.

— Ms. Ronea Alger, SMC Public Affairs



## CW keeps space operations running

Essential elements of infrastructure that support the Department of Defense satellite programs are provided by Space and Missile Systems Center, Los Angeles Air Force Base, Calif., satellite and launch control systems program office, or CW.

CW does this through a \$400 million program with 278 people, 100 of which are at SMC. The other 178 people are spread out across the nation at Peterson and Schriever AFBs, Colo.; Vandenberg AFB and Onizuka AFB, Calif.; and Patrick AFB, Fla.

CW's mission is centered around two infrastructures: the Spacelift Range System and the Air Force Satellite Control Network. Both are vital to the health and status of our satellites. No

rocket could be launched nor any satellite remain in orbit without their behind-the-scenes support.

"We have development and sustainment responsibilities for those two infrastructures," said Col. Barry Morgan, director of the Satellite and Launch Control office, "and they represent facilities around the world worth \$10 billion. We have to keep them running. We have to modernize them as the operations concept changes, as the booster program or satellite programs change their direction, and we have to make sure they're capable of supporting the Space Command mission 24 hours a day."

— Maj. Mary MacLeod, LAAFB

## MightySat: small but mighty and

If you've watched cartoons anytime in the last 45 years, you probably know that the lyric, "Here I come to save the day," means that enduring children's superhero Mighty Mouse "is on the way!"

But a television crusader isn't the only small but mighty object headed skyward on an important assignment. Launched July 19, aboard a Minotaur II from Vandenberg Air Force Base, Calif., the latest Air Force Research Laboratory satellite experiment, dubbed MightySat II.1, embarked on a one-year mission not to fight injustice, but test performance on new space technologies.

According to MightySat program manager Mr. Randy Kahn of AFRL's Space Vehicles Directorate, "The 266-pound MightySat II.1 is a relatively low-cost satellite about the size of a small refrigerator and the

second of its kind built and tested here. Built by the Spectrum Astro Corporation under contract to AFRL, it will fly a number of advanced technology experiments that are not only critical to spacecraft subsystems' future, but eventually, to the warfighter.

"Our highly successful MightySat I, launched from the Space Shuttle Endeavor's cargo bay December 14, 1998, demonstrated five other forward-looking experiments that have improved our operational understanding of how new technologies actually work in space," Mr. Kahn said. "We expect MightySat II.1 will do the same."

MightySat II.1's primary payload is a Fourier Transform Hyperspectral Imager able to detect and accurately discern different objects by recording their individual spectral "signatures," or the light they reflect. FTHSI will help the warfighter "see" more details on the





## DMSP: it's more than just a weather report

Vandenberg Air Force Base, Calif., Dec. 12, 1999, it carried with it a next-generation weather satellite developed and purchased by Space and Missile Systems Center team members.

Launched into low earth, polar orbit 180 miles up, the Defense Meteorological Satellite Program was putting up its newest version designed primarily to provide weather and oceanographic data for global forecasting and military operational planning.

"The next-generation satellite we launched in December is a dream for our warfighters," said Col. Jeff Quirk, DMSP program director. "It accommodates larger sensor payloads than the earlier generation and provides more advantages over former ones."

The new version features solid-state data recorders and a more powerful on-board computer to provide greater autonomy and five times the data receiving capability. The addition of a third battery increases spacecraft life from about four to five years.

"There are indeed commercial spin-offs from our weather satellite operations," Col. Quirk said. "Our satellites have made it easier for meteorologists to bring accurate weather forecasts into the living room."

DMSP also benefits the civilian community by routinely providing its weather pictures through the National Oceanic and Atmospheric Administration. This includes data for

research, according to Col. Quirk.

The military's need for weather satellites is important to battlefield commanders engaged in war. It can make the difference between success or failure. "For more than three decades, our warfighters have relied on DMSP to help plan refueling of aircraft, rescue missions, and attacks around cloud cover, winds aloft, thunderstorms and ice," said Col. Quirk.

DMSP provides data about the space environment that is critical in predicting the performance of high-frequency communications systems and over-the-horizon radar. It has the unique capability of providing soil-moisture measurements to help commanders avoid deployments through muddy terrain.

"Weather also effects air strike target acquisition, performance of aircraft and weapons systems, as well as assessment of mission success. Accurate data is critical to choosing the right tools and timing needed to put our bombs on target," he said

DMSP feeds encrypted data to numerous weather stations on land and sea around the world. U.S. and allied forces in the field can transport small tactical terminals wherever they go, receiving data directly from the satellites.

— Mr. Hap Parker, LAAFB Public Affairs



*A technician prepares the next-generation Air Force weather satellite for the December 1999 flight into orbit. (Photo by Mr. Russ Underwood)*

## headed skyward on an important assignment

# CSEL replaces Vietnam-era radios

Needing a better system to locate downed combat personnel became evident in the aftermath of the Serbian shoot-down of Air Force Capt. Scott O'Grady's F-16 Falcon over Bosnia in 1996. Capt. O'Grady was stranded for six days following the shootdown due to inadequate communications and navigation equipment aircrews had available then, said Lt. Col. Norm Albert, program manager for the Combat Survivor Evader Locator, Global Positioning System Joint Program office.

Designed at Los Angeles Air Force Base, Calif., Space and Missile Systems Center's development planning directorate, the Combat Survivor Evader Locator system, or CSEL, is the next generation combat search and rescue communication system.

The Global Positioning System Joint Program office at Los Angeles for the Defense Department currently manages the system and ensures combat personnel have a reliable and effective means of being quickly located, tracked, rescued and returned to friendly hands.

The original need for an improved combat search and rescue capability grew out of deficiencies identified in Southeast Asia, and later during Desert Storm, where inaccurate situational awareness information contributed to losing personnel and equipment.

The locator system is the first combat search and rescue system to incorporate a precise global positioning systems module, coupled with a multi-satellite, over-the-horizon communications capability tightly packaged in a hand-held unit weighing slightly less than two pounds. The locator's battery power can last 19 days.

The system, with a target cost of \$5,000 per radio, is

scheduled for fielding in fiscal year 2002. Produced by Boeing of Anaheim, Calif., the Pentagon intends to acquire more than 45,000 CSEL radios for the Air Force, Army and Navy aircrews to replace the old, Vietnam-era radios which have limited communications capabilities.

Existing survival radios are only effective if friendly forces are within line-of-sight communication and offer little to counter the possibility of enemy intercept or jamming. This system gives the warfighter capability to communicate over the horizon directly with search and rescue forces around the globe. The locator system architecture is composed of three segments. The user equipment segment consists of the multi-function, software re-programmable radio incorporating the

latest GPS anti-jam and anti-spoofing technology that enables the downed crewmember to transmit his or her precise location to rescue forces.

The satellite communication segment incorporates four worldwide ultra-high frequency base stations providing two-way secure

messaging and location. The ground segment contains the Joint Search and Rescue Center software application that facilitates communications with the downed crewmember and interfaces with existing command and control systems.

Combat search and rescue missions have historically experienced a low success rate because existing survival radios can be easily monitored and located by the enemy. This system brings today's commercial technologies to bear in resolving those deficiencies and greatly improving the chances of aircrew survival.

— 1st Lt. Tonya Summerall, LAAFB Public Affairs

**"...I had six days of trying to communicate with somebody.... Once I made communication, I was out in five and a half hours..."**

**Capt. Scott O'Grady during interview with Larry King**



**U.S. Marine Pvt. Santangew (left) and Cpl. W.D. McLeod (right) provide cover fire during a simulated hostage rescue mission. CSEL radios will help locate downed military and hopefully prevent hostage and POW situations. (DOD photo by Lance Cpl. C.D. Clark, U.S. Marine Corps.)**



# GPS revolutionizes warfighting capability

"The global positioning system allows users to calculate their location anywhere on earth," said Col. Douglas Loverro, director, GPS Joint Program office, Space and Missiles Systems Center, Los Angeles Air Force Base, Calif. "Today there are approximately four million GPS users around the world, military and civilian, and in 10 years, that figure will increase to 50 million."

There are currently two satellite-based navigation systems. The NAVSTAR GPS is owned and operated by the United States Department of Defense, managed by the NAVSTAR GPS Joint Program Office, Los Angeles. The Russian Federation owns and operates the GLONASS system.

NAVSTAR GPS is a space-based radio-positioning system featuring at least 24 orbiting satellites that provide navigation and timing information to military and civilian users worldwide. The system also consists of a worldwide satellite control network and GPS receiver units that pick up signals from the satellites and translate them into position, velocity and time information.

"GPS is powerful," said Col. Loverro, "and it's important. It's intricately interwoven into the fabric of our nation and is getting more so everyday. It is taken for granted in this interaction. You take on faith that GPS will be there. But it's much more than an act of faith."

"The NAVSTAR GPS joint program office at SMC is a multiservice, multinational organization conducting the development, acquisition and sustainment of GPS systems and resources," said Col. Loverro.

## Space Segment

GPS uses the characteristics of radio transmissions for location determination. Unlike previous navigation systems using ground-based transmitters, satellite-based transmitters are used to cover the earth with higher accuracy than available from land-based systems. The satellites transmit timing, satellite location and satellite health information.

## User Segment

The user requires a GPS receiver to accept the transmissions from the satellite. The GPS receiver contains a specialized computer that calculates the location based on the satellite signals.

The user does not have to transmit anything to the satellite and the satellite does not know the user is there. There is no limit to the number of users that can be using the system at any one time.

## Control Segment

The satellites are controlled and monitored from ground stations. The control stations monitor the satellites for health and accuracy. Maintenance commands, orbital parameters and timing corrections are uploaded from the ground on a periodic basis.

"For the military, GPS provides critical services including situational awareness and precision weapon guidance," said Col. Allen Ballenger, user equipment division chief. "This dual-use satellite has also spurred economic growth in many consumer sectors. It's opened whole new ways of doing business."

The Air Force uses GPS for bomb and missile guidance. Conventional air-launched cruise missiles launched from B-52s did go to war over in Kosovo as part of Operation Allied Force last year. These missiles contained single-channel GPS receivers which were quickly integrated into the missile's existing navigation system. In Kosovo, B-2s were able to drop bombs through the rain, clouds and in complete darkness with tremendous precision. Our new satellite-guided weapons, joint direct attack munitions, and joint stand off weapons work. Both rely on GPS.

"The Air Force completely underestimated the benefit GPS has brought to modern warfare," said Col. Loverro. "There has been a revolution in the military and our ability to fight because of GPS. It provides not just unheard-of precision in navigation, but unheard-of precision in time that is unrivaled in human history."

"Civilian industries have also come up with all sorts of ideas and innovations on how to use GPS," said Col. Ballenger. "Some of them are very important as well as creative."

GPS is being used by scientists to study the ongoing deformation of the crust in Southern California caused by the San Andreas fault and other faults in the Los Angeles area. The Southern California Integrated GPS Network measures the millimeter-scale movements of the crust between earthquakes, and also records displacement of

stations during earthquakes. GPS also measures the size of an earthquake by examining the final amount that a station has been displaced in an event.

GPS is also being used to track a herd of 1,500 elk in northern New Mexico. It provides information on the animals' location and migratory habits.

"The decisions we make here will affect the entire world in ways we can't

## Modernization increases capability

"The NAVSTAR Global Positioning System is currently undergoing dramatic modernization changes to its architecture," said Col. Douglas Loverro, director, GPS Joint Program office. "These changes set the stage for the next generation — GPS III."

Over the last several years, Department of Defense has been studying the need to improve GPS capabilities to meet the needs of the military. A new, more secure military signal with more power is needed especially under hostile conditions.

"To the military, modernization means more and better. We'll be putting more signals out there, a new military signal just for military use," said Col. Loverro. "This signal will provide more resistance to enemy action and higher accuracy. It will give the warfighter unimaginable ability to target enemy forces."

To make GPS a more useful and robust system for national and international civil use, greater accuracy availability and integrity is needed from the civil signal. To provide a more robust signal, a second civil signal will be added to the GPS signal architecture. In addition, a third civil GPS signal at a new frequency will be added for use in safety-of-life applications.

"To the civilian world, once again, GPS modernization means more and better signals than we have today. In fact, within 30 years, any airplane you fly on will use this signal as its sole means of navigation precision and landing," said Col. Loverro. "We will not only be relying on GPS to get us from place to place, but airplanes will rely on it to land safely."

— Ms. Peggy Hodge, AFFTC Public



**X-38 Ship 2 is released  
from a NASA B-52**

**X  
MEN**

**Edwards opens access to space**

**S**ince the Roman Empire, military commanders have wanted to own high ground needed to dominate the battlefield.

With today's ever-advancing technology, that ancient philosophy remains even more applicable. But instead of rocky slopes, the modern high ground is space. And instead of foot soldiers serving as lookouts, it's satellites sailing quietly thousands of miles overhead.

Launching a satellite into space, however, is a little more difficult — and more expensive — than it was ordering a legionnaire up a hill.

### Lowering costs

Today, it costs \$10,000 per pound to put satellites into space. The Air Force, and it's space partner, NASA, would like to see this bill lowered to \$1,000 per pound because reaching and keeping the high ground in space is becoming an increasingly significant and frequent endeavor.

And corporations, who are moving more and more into dealings in space,

also would like to see a price tag with fewer zeroes.

Consequently, there's going to be tremendous research focused on reducing today's high cost of space travel, said Col. Don Thompson, director of the Air Force Flight Test Center's Access to Space Office at Edwards Air Force Base, Calif.

### Access to space

The 15-man office that Col. Thompson oversees is tasked with providing Air Force support for NASA and commercial access-to-space flight test activities, and assessing leading-edge technology for potential military use.

One such endeavor is the X-33 technology demonstrator. A wedge-shaped, unmanned vehicle, the X-33 is a half-scale version of a planned single-stage-to-orbit reusable launch vehicle called VentureStar — a possible replacement for an aging space shuttle system. Unlike the shuttle, which piggybacks on booster rockets and fuel tanks, a single-stage-to-orbit vehicle is

self-contained and doesn't need external power.

The aim of any reusable launch vehicle program, such as the X-33, is "...to build a vehicle that takes days, not months to turn around; dozens, not thousands, of people to operate; with launch costs that are a tenth of what they are now," said Mr. Dan Goldin, NASA administrator.

### Recapturing lost business

Developing such technology hopefully will result in the United States "...recapturing lost space business and provide an operational advantage to the military mission," said Mr. Johnny Armstrong, deputy director of the access to space office.

Obviously, maintaining a celestial high-ground edge with fewer resources would be one such benefit.

Another family member of the reusable launch vehicles being tested at Edwards to reduce launch costs is the X-34. Also an unmanned vehicle, X-34 is undergoing ground taxi tests now and



will be conducting glide flight tests from an L-1011 aircraft soon. Later, powered flights will be held to reach approximately 4,000 miles per hour and 250,000 feet.

The X-33 and X-34 are just two of several experimental vehicles that the Access to Space office is cooperating with NASA on during development. Working in close alliance with NASA Dryden Flight Research Center, located at Edwards, and various contractors, the office also is supporting X-37, X-38, X-40 and X-43 programs.

Not since the 1950's has there been so many X planes here, Col. Thompson noted.

### Deploying a lifeboat

One of the more prominent is the X-38, which NASA hopes to deploy around 2005 as a lifeboat for the International Space Station, replacing a Russian Soyuz capsule.

Current flight tests are underway to develop the X-38's parafoil landing system. Later flights will include reentry and landing after the spacecraft is deployed from the shuttle during an actual orbiter mission.

X-38 program officials say the project has two purposes. First is to prove that a low-cost return vehicle for the space station can, indeed, be built. Second is to show that a human spacecraft can be developed for a price much lower than expected. Originally, the crew return vehicle project was estimated to cost \$2 billion in the late 1980's. But under the current plans, NASA hopes to build one and test-fly it in space for a tenth of that.

One reason is the X-38 uses a lifting body design already proven and tested more than 30 years ago with the X-24A from 1969 to 1971.

### It began here

In fact, with flight tests done in the 1950's and the 1960's on hypersonic aircraft such as the X-20 Dynasoar and the X-15, one could say Edwards is where much of reusable launch vehicle research began.

"Someone at AFFTC has been involved — hands-on, not looking over someone's shoulder — from the early hypersonic days to the space shuttle and now to a new generation of X vehicles," said Mr. Armstrong, who has served as an engineer on every X vehicle for the last 40 years.

"We have partnered with NASA for decades in exploring the unknowns of the hypersonic flight regime," he said.

There is one big difference, though, between now and the '50s: who's flying these experimental crafts — or more importantly, who isn't.

### A new dimension

"The current series of X vehicles are extremely advanced," Mr. Armstrong said. "Unlike their predecessors that had pilots in the cockpit, these vehicles are all unmanned, which adds a new dimension and complexity to flight testing."

Contributing to these experimental programs are access to space engineers who all have extensive backgrounds and irreplaceable experiences in the design and testing of hypersonic vehicles and rockets, said Col. Thompson. That experience base includes the X-15, lifting bodies, space shuttle entry and landing, expendable launch vehicles, intercontinental ballistic missiles and fighter, bomber and cargo aircraft.

Additionally, the access to space office provides project management of rocket engine testing for and by commercial customers at rocket facilities operated by the Air Force Research Lab Propulsion Directorate at Edwards.

As for the future, Col. Thompson believes the access to space office "...will be around for a while." "If you look at the Air Force's newest vision statement," he said, "we are merging air and space into an aerospace force, and we are moving out into space. Currently, we are an office, but I can see us one day growing into a combined test force."



*The second X-38 prototype of a Crew Return Vehicle for the International Space Station flares for landing on the dry lakebed at Edwards Air Force Base, Calif. (NASA photos)*

— Mr. Ray Johnson, AFFTC Public Affairs



*The X-33 will fly over the Utah desert after returning from a suborbital flight. The first test launch of the X-33 is scheduled in 2002. (Artwork courtesy of NASA)*



# First Loral satellite arrives at AEDC



**A** C-5C Galaxy cargo plane from the 60th Air Mobility Wing, Travis Air Force Base, Calif., delivered a Space Systems/Loral Geostationary Operational Environmental Satellite to Arnold Engineering Development Center, Arnold Air Force Base, Tenn., July 12.

Preparations for the satellite's arrival have been in the making for five years. The center submitted an estimate for testing Loral's communication satellite systems in 1995 and the two organizations recently signed a 10-year contract, boosting Arnold's workload through 2009.

The contract funds testing an average of two to three satellites per year, which officials say translates into about \$30 million.

It also included \$1.5 million for a significant capabilities upgrade to Mark I, a space simulation chamber. By the end of 1999, Mark I had been transformed from a 1960s era facility into a modern 21st Century space chamber.

According to AEDC officials, these upgrades were the first major improvements on the test chamber in three decades.

The upgrades will make it a prime candidate for testing Department of Defense and commercial industry space systems in the future.

Headquartered in Palo Alto, Calif., Loral designs, builds, tests and operates satellites, subsystems and payloads used for commercial communications services including cellular telephones and television systems.

Since 1960, the company has designed or built some 190 satellites. AEDC engineers will test between 30 and 40 new satellite systems for Loral during the contract period.

"The arrival of the Loral stationary satellite represents two new eras for AEDC," said Col. Michael Heil, center commander.

"It represents a welcome addition to our family of industrial alliances bringing more business to AEDC and middle Tennessee. This is just one more way to secure the center's future and to show the importance of space work in our future.

"Also, it is the first major test article of its size to be transported via air to the center since the air strip's reopening this spring. We hope it will set a precedent and open new avenues for more customers to use our facility."

— Ms. Dana E. Davis, AEDC Public Affairs



*This C-5C from Travis Air Force Base, Calif., has been modified to accommodate payloads like the Space Systems/Loral Geostationary Operational Environmental Satellite. A truck can be driven through the open nose of the plane into the cargo hold to load the GOES satellite. (Photos by Ms. Dana Davis, AEDC Public Affairs)*



**E**ach day more than 400 people assigned to the Space Based Infrared System program office carry out duties to ensure requirements for the nation's next-generation missile early warning system stay fulfilled to meet the warfighter's needs.

"We research, develop and acquire systems to keep America safe from missile threats," said Col. Daniel Burkett II, SBIRS program director at Los Angeles Air Force Base, Calif. "Our Defense Support Program has been deployed for nearly three decades and has done a marvelous job for us," he said. "It has allowed us the surveillance flexibility to support U.S. warfighters, allied forces and intelligence communities."

Future plans and initiatives call for updates involving infrared platforms to improve ability to safeguard the nation from missile attack. The program has an infrared mission capability to provide surveillance from space in four mission areas: improved missile warning, missile defense, battlespace characterization and technical intelligence.

"It's like having eyes in the sky," said Col. Burkett.

SBIRS' purpose is to develop a satellite system that provides increased performance over the existing Defense Support Program system, or DSP.

The system's primary mission is to provide initial warning of a ballistic missile attack on the United States, its deployed forces and allies by incorporating new technologies to enhance detection; provide direct reporting of intercontinental ballistic missiles and tactical ballistic missile launches; and provide critical mid-course tracking and discrimination data for national theater missile defenses.

"The systems will consist of sensors located in geo-synchronous orbits, highly elliptical orbits and low earth orbits playing a crucial role in the nation's space-based defenses well into the next century," said Col. Burkett. SBIRS is scheduled for deployment by 2010.

### **SBIRS High**

The first of these new initiatives is SBIRS High, which will place a mix of four satellites in geosynchronous orbit at about

23,000 miles above the earth. The system is designed to gather missile warning and battlespace characterization data and feed the information to a new consolidated ground processing station.

"SBIRS High is far more than a DSP replacement," said Col. Burkett. "Significant improvements in sensitivity and pointing agility will provide a more robust surveillance capability."

In addition, the sensors will be more flexible and powerful than those on the current DSP satellites. While the sensors on DSP satellites scan the earth in a fixed pattern, SBIRS High adds a second sensor to each satellite that can be directed to "stare" at specific areas of interest on the earth.

The SBIRS High component is being developed to have two payloads in a highly elliptical orbit with its first delivery in 2002. The first of four geosynchronous satellites is planned for launch by 2004. The full system will be deployed by 2008.

The first incremental delivery of SBIRS High — consolidating multiple ground stations now located around the world to a single station in the U.S. — also will consolidate processing of strategic and theater missile detection.

The consolidated ground station is scheduled to begin its initial operational test this year with an initial operational capability in mid-2001.

### **SBIRS Low**

To complement SBIRS High will be the SBIRS Low component which will have 24 satellites in a low earth orbit about 1,000 miles above the earth.

"SBIRS Low provides the capability to perform mid-course tracking of ballistic missile re-entry vehicles to support improved missile warning and missile defense," said Col. Burkett. "The addition of the component also enhances SBIRS' capabilities in all other mission areas."

SBIRS Low is a passive, space-based, sensor surveillance system consisting that will interact with numerous existing and future surveillance, warning, control networks, command and control centers and other elements.

— Ms. Ronea Alger, *SM* **LEADING EDGE • SEPTEMBER 2000 • 13**

# ABL takes laser to new heights

Destroying scud-like missiles such as those used in the Gulf War is a feat the Space and Missile Systems Center's Airborne Laser program office located at Kirtland Air Force Base, N.M., is currently developing.

The program office's mission is to develop a laser powerful enough to extend hundreds of miles to destroy missiles that could be traveling nearly a mile per second.

## Speed-of-light

Sophisticated sensors and optics must spot the missile shortly after launch and direct the laser, keeping it focused on its fast-moving target. Corrections must be made for the atmosphere, which typically distorts and spreads the laser beam.

"This 'speed-of-light' weapon will give our warfighters the ability to destroy theater ballistic missiles in their boost phase while over enemy territory," said Col. Michael Booen, former Airborne Laser System Program office director. "We're more than 40 percent complete, and still on cost and schedule. The individual technologies are proven and jet modifications are underway."

## High priority program

As one of the Air Force's highest priority programs, the airborne laser involves a series of weapons-class lasers aboard a modified Boeing 747-400 series freighter aircraft and uses those lasers to destroy theater ballistic missiles shortly after their launch. The aircraft is designated the YAL-1A Attack Laser.

The airborne laser cleared a major hurdle in January when it took delivery on aircraft number 00-0001, destined to be the anti-missile system's first flying platform.

The aircraft, fresh off the line at Boeing's Everett, Wash., plant, was flown to the Boeing facility at Wichita, Kan., where it will undergo 18 months of modification to bring it on board as the first of an envisioned fleet of seven ABL 747s.

## Modifications

The most visible sign of the work will be adding a 14,000-pound nose turret, which will replace the conventional 747 nose cone. The turret, shaped like an elongated oval with eye-like windows, will house the laser firing mechanism.

Work is underway by the other two contractor members of



Team ABL — Lockheed Martin and TRW — on other components vital to the system's operation.

Under the \$1.3 billion contract for the first phase of the plan — the Program Definition and Risk Reduction segment — the contractors have distinct responsibilities. Boeing, in addition to building the aircraft, will manage systems integration and develop the computers and software necessary for communications, intelligence and laser operation.

TRW Space and Electronics Group of Redondo Beach, Calif., will perfect the chemically operated laser. Lockheed Martin Missiles and Space of Sunnyvale, Calif., will be in charge of developing the beam-and-fire control system.

## Aircraft of the new millennium

Under the current plan, the first Air Force craft of the new millennium will fly to Edwards AFB, Calif., in March 2002 where an operational battery of six lasers will be installed. The schedule calls for a series of live-fire tests to begin in 2003.

## Putting it to the test

In April, ABL conducted its pivotal critical design review, a point-by-point examination of the entire system.

"Since we have done the individual pieces, it was time to step back and make sure we are all on the same page," said Col. Ellen Pawlikowski, who took over as ABL program director early in April.

"What we found was that we exceeded all the requirements; we're very comfortable with what we learned," she said. "Now it is time to build the hardware, put it together and test it."

— Mr. Ken Englades, ABL Public Affairs



# Lifting the "fog of war"

## Revolutionary technology clears view of battlefield

Despite the best-laid plans of military tacticians, confusion often obscures the battlefield once the shooting starts. Part of good tactical planning to minimize what soldiers historically have termed the "fog of war" relies on field commanders and their ability to collect adequate information about the battlefield. But first they must be able to "see" the terrain clearly and identify objects, friend or foe, on it.

Now, as a result of revolutionary "hyperspectral imaging" technology being developed in part by the Air Force Research Laboratory's Space Vehicles Directorate at Kirtland Air Force Base, N.M., planners may soon command a much clearer view of contested ground.

### Reflected energy

"Our Warfighter-1 hyperspectral imaging instrument is a satellite-based technology that uses different sensors to "see" reflected energy from objects on the ground," said Lt. Col. Mark Woish, Warfighter-1 program manager. "This energy appears in the form of 'spectral fingerprints' in the visible, near infrared and short wave light spectrum."

Once these fingerprints are detected, special algorithms — repetitive, problem-solving mathematical calculations — then assess materials from one another. "Signature" libraries may also be used to identify specific materials such as rooftops, parking lots, grass, or mud, by comparing a library's pre-existing reference catalogs with freshly taken hyperspectral images of the battlefield from space.

Image processing equipment then portrays the various types of terrain and

objects upon it in different colors, each based on the wavelength of the reflected energy captured by the image. These colors are subsequently "translated" into maps that correspond to certain types of

AFRL's Warfighter-1 payload is slated for launch sometime in 2000 and will evaluate how well hyperspectral imaging works under actual space conditions.

"The heart of the payload is a three-mirror optical telescope and imaging sensors with related electronics that will enable visible, near-infrared, and short wave cameras to capture images on the ground useful to the warfighter," Lt. Col. Woish said.

AFRL will eventually use a mobile ground station to process hyperspectral information in real-time for theater use.

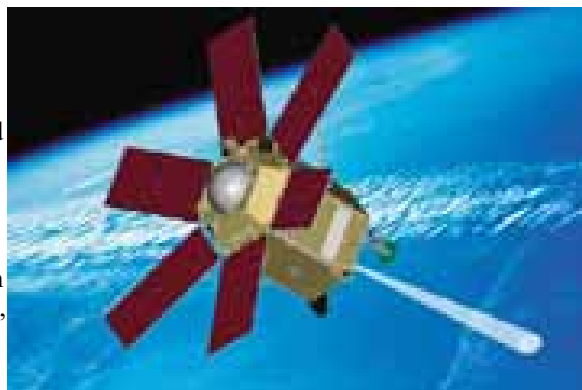
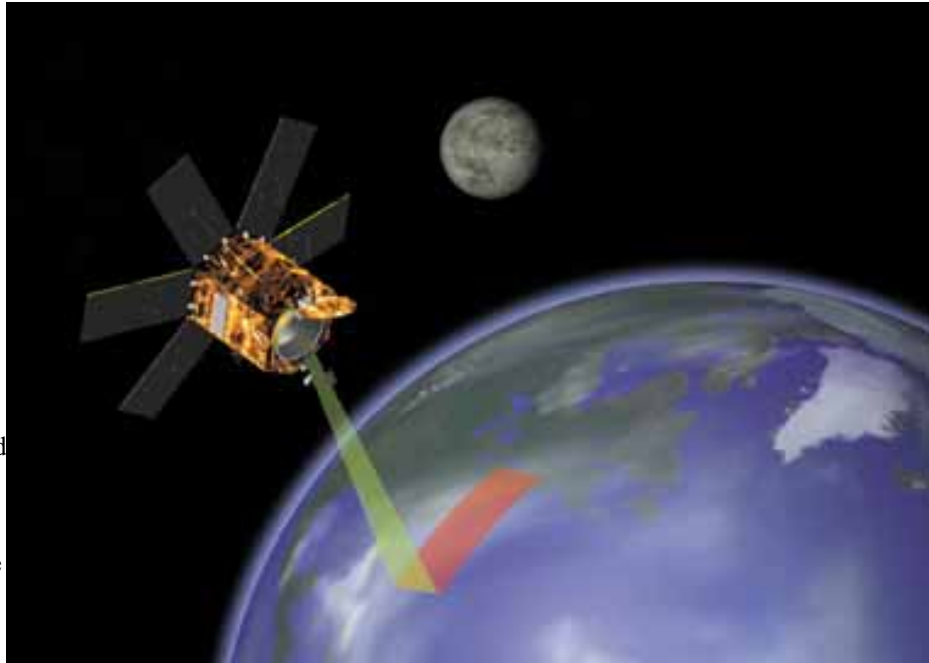
### Collecting images

The satellite will collect the images as directed by the ground station and transmit them back to the ground station on the same satellite pass. The station will have image-producing hardware and software for finished images in near-real time, which is critical to theater commanders for them to keep pace with rapidly changing conditions.

"Once hyperspectral-imaging technology is better understood, a new, vital tool will be available to support military planning and field operations," said Lt. Col. Woish. "The next evolutionary step for this technology will be to integrate it with other sources of information-gathering tools, such as live video, electro-optic imagery, synthetic-aperture radar or electronic intelligence.

"Then the warfighter will truly be able to see the battlefield more clearly and, at least in part, lift the 'fog of war.'"

— Mr. John Brownlee, AFRL Public Affairs



material or objects to detect or identify military targets such as a tank or a mobile missile launcher.

### Using color maps

These algorithms can also categorize types of terrain and vegetation (useful in counter-narcotic operations), detecting features such as disturbed soil, stressed vegetation, and whether the ground will support the movement of military vehicles.

# AFRL “Weightwatchers” peel away the pounds

The latest brainchild of the Air Force Research Laboratory Space Vehicles Directorates, to reduce the bulk and weight of future space systems looks

kind of like a huge contact lens for a myopic Jolly Green Giant or a transparent flying saucer.

“What you’re really seeing here is a potential solution to an important, ongoing problem in the space business: How to shrink the weight of spacecraft and, as a result, lower expensive launch costs,” said Mr. Bob Acree, project manager for inflatable space structures at the Kirtland Air Force Base, N.M. facility. “We, and our commercial partners at SRS Technologies in Huntsville, Alabama, are also examining the inherent possibilities of inflatable technology to reduce the volume of stowed payload in launch vehicles,” said Mr. Acree.

## Shrinking weight

“By using thin-film, a NASA-developed plastic like this membrane, we can shrink payload weight and the pre-launch mass of some fairly large structures — antennas, radar dishes, sensors, telescope optics — down to a few hundred pounds rather than the thousands of pounds comparative metal structures weigh today. Then, once the system is in orbit and ready for deployment, an inert gas will re-inflate the structure, like a life raft.”

## Critical limitations

When considering spacecraft design, weight and volume have always been critical limitations, not only for the Air Force, but also for the space industry at large. The standard cost estimate commonly used for every pound placed into

orbit is \$10,000. Consequently, the lighter and smaller the payload, the cheaper the class of launch vehicle can be used.

By developing technologies that both compress a payload’s

volume for launch — either by folding or collapsing — AFRL enables placement of much larger, not heavier, structures in orbit. Once in orbit the payload then unfolds, or in this case inflates, back to its operational size and configuration.

“And in space, size dominates, especially if you want to find relatively small things on earth and see them clearly by using space-based radar, sensors, or a telescope,” said Mr. Acree.

## Thin-film cheaper

“If you are designing structures for high-altitude surveillance missions, you want to put up the largest system you can,” he said. “And the bigger the structure, the more detailed picture you get of objects on and above the ground. But we must work within reasonable cost limitations.

“Here at the lab, our thin-film, inflatable technology has potential to be about 10 times cheaper and 10 times lighter than current structures, and

also permits payloads that are at least 10 times smaller in volume than today’s mechanically deployed structures,” said Mr. Acree. “Right now, we think inflatable membranes hold genuine, efficient possibilities for such spacecraft as solar orbit transfer vehicle concentrators and radio frequency antennas.”

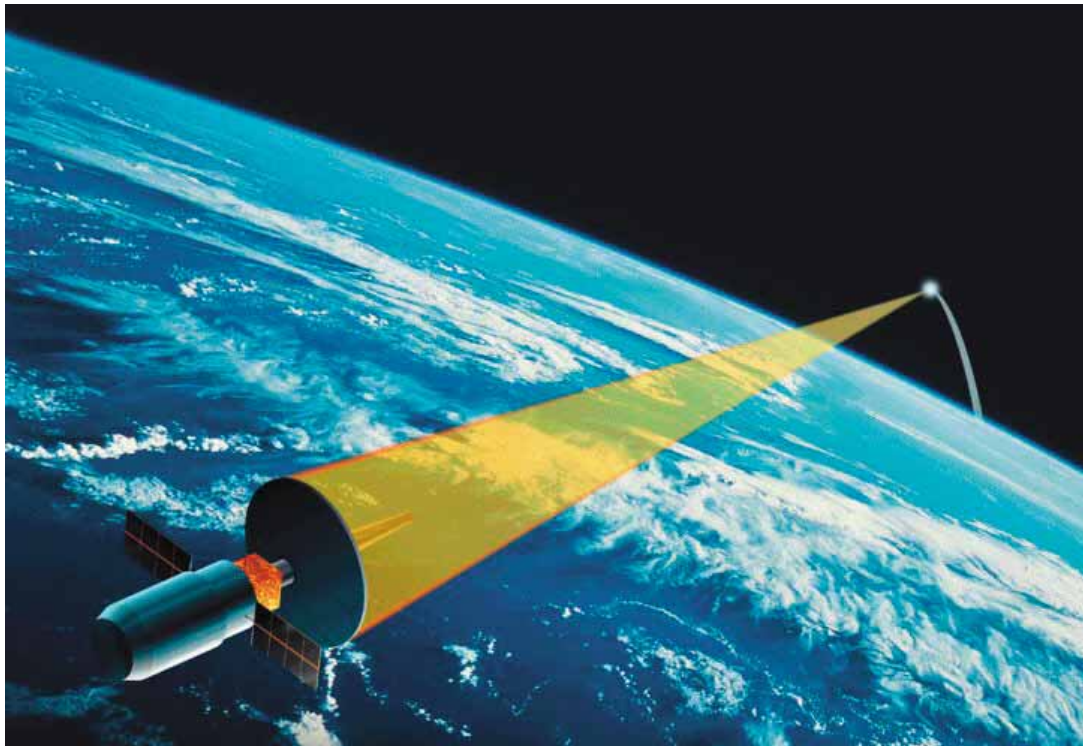
AFRL is planning a demonstration flight for thin-film inflatables within the next six years.

— Mr. John Brownlee, AFRL Public Affairs



*Space Vehicles Directorate at Kirtland Air Force Base, N.M., engineers prepare an inflatable membrane for testing in the directorate’s structures and controls lab. Looking a lot like a giant contact lens, this experimental lightweight device may pave the way for future, inexpensive weight-saving technologies that enable the creation of large space structures. (Photo by Mr. Art Goodman)*





*The SBL IFX is designed to gather data to determine the feasibility of deploying an operational space-based laser system in the future. The latest efforts, led by the Air Force in cooperation with the Ballistic Missile Defense Organization, will advance and integrate the technologies to build the new system. The IFX space vehicle is planned to launch in 2012 for a 3-year mission. The primary goals of IFX are to validate SBL as a viable option for missile defense while obtaining performance and operations data.*

## Lab evaluates satellites' vulnerability to lasers

One by one, the world's orbiting satellites are being evaluated for their vulnerability to lasers. Driven by a new Defense Department directive, the work is being done by the Satellite Assessment Center of the Air Force Research Laboratory's Directed Energy Directorate at Kirtland Air Force Base, N.M.

"The work we're doing in response to this new defense directive reflects two factors: there is an increasing number of satellites in space and some of these satellites are particularly vulnerable to laser radiation," said Capt. Brian Oelrich, chief of the center's optical analysis group.

"When you couple this vulnerability to the increased use of Department of Defense high-energy lasers, said Capt. Oelrich, "actions were needed to prevent inadvertent laser damage to these satellites."

High-energy lasers currently in development include the Airborne and Space Based Laser, and the U.S. Army's Tactical High Energy Lasers. Other lasers are used for detection, ranging, tracking, communications, calibration and imaging.

Any DOD agency wanting to fire a laser above the horizon must first get permission from U.S. Space Command's Laser Clearing House, which uses the center's information on

satellite vulnerabilities to help determine if there are any satellites in the laser's path that should be avoided.

Specifically, the Satellite Assessment Center uses detailed satellite intelligence coupled with laboratory laser effects testing on actual spacecraft components and materials to build high-fidelity computer models of foreign and domestic satellites. From these models, the safe levels of laser illumination for a particular satellite can be determined.

Also factored in is the operation and orientation of a particular satellite in relation to the proposed laser scenario.

An analysis for each satellite and scenario can be costly. To help minimize this cost in the future, the center is also developing software upgrades that will give U. S. Space Command the ability to screen satellites in-house. This software includes a center-developed satellite vulnerability database that can perform timely predictive avoidance analysis.

The Satellite Assessment Center was selected for this assessment because of its three decades of experience studying satellite vulnerabilities and its in-depth knowledge of satellite materials, properties and intelligence.

— Mr. Juventino Garcia, AFRL Public Affairs

## EELV makes space launches more affordable for the nation

The Evolved Expendable Launch Vehicle Program Office recently received a top-level award for its efforts in saving the Air Force \$5 to \$7 billion.

EELV's innovative payload-to-launch vehicle integration design and standardization of booster cores earned the program office the 1999 Defense Standardization Program National Honorary Award.

The driving force behind the EELV program is the effort to make space launch more affordable for the nation by using a family of unmanned, expendable space launch vehicles that have evolved from existing systems. These will comprise the Department of Defense's sole source of expendable medium and heavy-

lift transportation to orbit.

EELV has joined with Lockheed Martin Astronautics Corporation and the Boeing Company to develop a national launch capability that satisfies the government's forecasted launch requirements and reduces the cost of space launch by at least 25 percent, said Lt. Col Jim Knauf, EELV and Delta IV program manager.

EELV is the first program designed to use a standard specification for government payloads that will use the same mechanical and electrical interface to the launch vehicle and will employ a standardized booster core. This new design will facilitate manufacturing, assembly, payload integration and launch operation process.

— 1st Lt. Tonya Summerall, SMC Public Affairs



### NASA Hyper-X program tests in Arnold arc heater

ARNOLD AIR FORCE BASE, Tenn. — NASA Langley Research Center is using the Arnold Engineering and Development Center H-2 arc heater to evaluate potential nose materials before flight testing three hypersonic air-breathing vehicles during the next two years.

“AEDC was the only facility that could provide us with the pressure we needed to evaluate the materials,” said Dr. David Glass, thermal protection systems and hot structures lead of NASA Langley’s metals and thermal structures branch. “Simulating flight conditions in the AEDC H-2 arc facility provides confidence that if the materials survive the AEDC tests, they will survive the flight.”

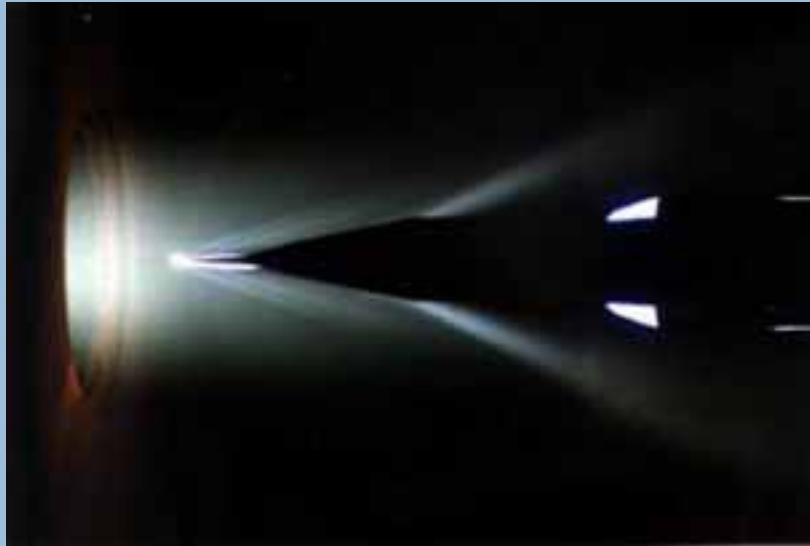
According to Dr. Glass, the first

two Hyper-X (X-43) vehicles will fly at Mach 7 conditions using a silicon carbide coated carbon-

be exposed to a more severe thermal environment exceeding the single-use temperature of Mach 7 leading-edge materials.

MicroCraft, Inc., Tullahoma, Tenn., is fabricating the Hyper-X flight vehicles for NASA.

“High-temperature coatings are being evaluated at AEDC in an effort to use passive material leading edges for the Mach 10 vehicle,” Dr. Glass said. “Ensuring these materials survive the flight is critical because leading-edge recession may contaminate the air-breathing engine and effect vehicle



carbon material for the horizontal control surfaces and nose leading edge. Those materials are designed to maintain maximum temperatures below 3000 degrees Fahrenheit.

The third, slightly different, vehicle will fly at Mach 10 and will

control.”

During the January to April tests, the H-2 team evaluated 24 wedge-shaped leading-edge samples at Mach 10 conditions of 2,200 Btus per pound and stagnation pressures of 1.2 atmospheres.

— AEDC Public Affairs

### Space Vehicles awards ITN \$35 million contract

KIRTLAND AIR FORCE BASE, N.M. — Air Force Research Laboratory’s Space Vehicles Directorate awarded \$35 million to ITN Energy Systems Inc., of Denver, Colo., to build three TechSat 21 satellites. The microsattellites will demonstrate formation flying.

“The availability of such low cost, highly capable microsattellites will lead to new ways of doing business in space and this ‘personal satellite’ paradigm can revolutionize the space industry in much the same way as the personal computer has done to the computer industry,” said Dr. Alok Das, chief technologist for the Space Vehicles Directorate.

The three TechSat 21 satellites will be built at approximately 120 kilograms (264 miles) each and will operate as a “virtual satellite” with X-band transmit and receive payloads on each. Technologies include precise differential GPS

positioning, intersatellite ranging and communication, advanced phased array antennas, micro-propulsion, multifunctional structures and lithium-ion batteries.

The Air Force, NASA and other government space agencies are making significant advances in reducing the size, weight, and cost of satellite subsystems.

Next generation microsattellites promise to be 10 times lighter and as much as 10 times cheaper than current systems with capabilities approaching those of larger class satellites of today. These lightweight microsattellites enable such new mission concepts as on-orbit satellite inspection and servicing, multiple-satellite formations, and aircraft missile launches of microsattellites for rapid response tactical missions.

### America, Australia unite to test weapon system

EGLIN AIR FORCE BASE, Fla. — The Air Force Research Lab Small Smart Bomb Program team and the

Royal Australian Air Force have combined forces to launch small smart bombs from the internal bay of an F-111 at supersonic speeds. The joint team was at the Air Armament Museum July 24 check-fitting an F-111 for bombing tests to be conducted in Australia later this year.

“The F-111 is the only aircraft in the free world that can drop munitions at supersonic speeds from an internal weapons bay,” Mr. Lockwood explained. “Currently the Air Force doesn’t have any aircraft that can do that, but it will when the F-22 Raptor and Joint Strike Fighter are added to its arsenal.”

Mr. Lockwood said that the test helps the Air Force identify and correct any problems the fighters may have dropping munitions at supersonic speeds.

New photometric software that will be used to analyze the munitions’ trajectory when they are released is also being developed for the Australians.

This project has been a major milestone for all involved.

Reported by Mr. Greg Davenport, AAC Public Affairs

## Power system innovation saves F-22 program \$330,000

The F-22 Combined Test Force at Edwards Air Force Base, Calif., recently posted program savings of more than \$330,000 with a dramatic new innovation in the testing infrastructure used for the Raptor.

The innovation, described as a technological breakthrough by Mr. Vern Renfrow, the F-22 test team's senior facility engineer, is a first-of-its-kind aircraft external DC power system. The system converts standard AC power available in maintenance hangars to a 270 volt DC system required to power the Raptor's avionics systems for ground tests.

One major asset of the next-generation fighter is a unique avionics suite. The F-22 flight test director, Col. C. D. Moore, said an ability to provide electrical power for avionics and electrical system ground testing and other functions is vital to the Raptor's avionics and flight expansion test program.

The F-22 power requirements are not found in any other aircraft, such as the F-15, F-16, B-1 or C-17 which use a 400-hertz system. Furthermore, the Raptor requires a power supply free of frequency variations and fluctuations.

Existing electrical supply systems in the F-22 hangars simply could not meet the power requirements of the F-22 without severe risk to both the aircraft's avionics and the integrity of the overall test program, Mr. Renfrow said.

To fix the problem, Mr. Steve Bridgers, the F-22 test team's senior supervisor for facility maintenance, analyzed existing hangar areas. His survey derived two solutions: regulating

input voltage and procuring a converter that would meet F-22 power requirements.

After studying both concepts, Mr. Bridgers determined neither option could be practically accomplished given currently available hardware in the aircraft industry. However, believing that use of a power converter was the proper method to solve the problem, he then developed a solid state power converter that would meet test team needs.

Mr. Bridgers' design provides the F-22 the power it needs and is the most efficient system of its kind in the aviation industry. Unlike all other converter systems, it's capable of operating continuously at full load, and even under the hottest desert climate conditions. Col. Moore said the system "has far exceeded all F-22 combined test-force requirements."

Mr. Renfrow said the new system takes up far less space than other design proposals, and it can power both the aircraft's avionics and systems simultaneously without a decrease in efficiency. The system has one power converter replacing the five portable power carts currently required to power the F-22 independently of hangar power supplies. Since its adoption, it has been a key ingredient of success to the F-22s' logistics test program.

The new system paves the way for future testing of 21st-century aircraft to include the Joint Strike Fighter and others that may soon undergo flight testing in the skies over Edwards.

— Mr. John Haire, AFFTC Public Affairs

### **Primary function:**

*Fighter, air-dominance*

**Wingspan:** 44 feet, 6 inches

**Length:** 62 feet, 1 inch

**Height:** 16 feet, 5 inches

**Powerplant:** Two Pratt & Whitney F119-PW-100 engines capable of supercruise and thrust vectoring

**Speed:** Mach 1.8 (supercruise: Mach 1.5)

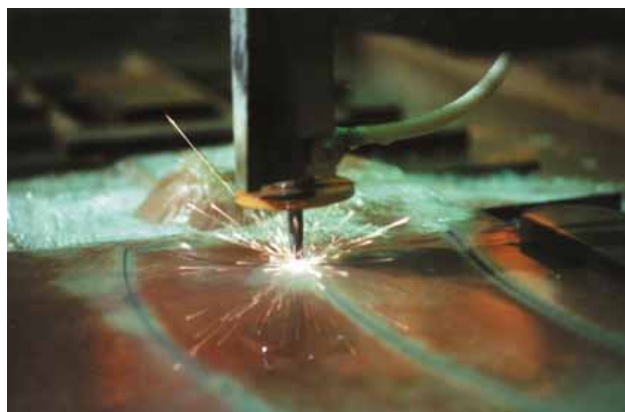
**Armament:** Two AIM-9 Sidewinders; six AIM-120C Advanced Medium-Range Air-to-Air Missiles (AMRAAM); one 20mm Gatling gun; and two, 1,000-pound Joint Direct Attack Munitions (JDAM).

**Crew:** One

**Builder:** Boeing and Lockheed Martin Corp.



**Right: Mr. David Roland cuts narrow grooves into a piece of aircraft-grade aluminum.**  
**Below: Close-up of waterjet cutter in action.** (Photos by Ms. Sue Sapp, WR-ALC)



## Waterjet cutters are natural solution to industrial needs

The Grand Canyon is one example of the awesome force of water. Another example can be seen at the Technological and Industrial Support Directorate at Robins Air Force Base, Ga., and you don't have to wait millions of years to see the results.

Waterjet cutters are a natural solution to industrial need. Each of the directorate's two robotic water-jet cutters sends a needle-thin stream of water mixed with an abrasive at up to 55,000 pounds per square inch, precisely slicing steel or titanium up to six inches thick and aluminum up to 11 inches thick. Guided by computer, it can repeatedly cut very precise and complex forms to a tolerance of .0005 of an inch, according to the directorate.

While the cutter is now used at other air logistics centers, Robins was the first to have one, Sheet Metal Manufacturing Section chief Mr. J.J. McClure said.

The five-axis cutter can shape parts with rounded contours, while the three-axis one handles flatter shapes. They can cut metal, wood, rubber, Plexiglas, plastics and other materials.

The abrasive is finely ground garnet, a reddish mineral. The residue is collected and discarded as an environmentally harmless sludge.

"In the past we would have had to do all this with a bandsaw," Mr. McClure said.

According to the directorate, the cutters eliminate the majority of band saw and hand cutting work, as well as grinding and deburring, for 80 percent of sheet metal parts, 25 percent of steel parts for welding and 10 percent of metal parts for the machine shop. Because the cuts are so precise, 35 percent less material is wasted in the process.

— Mr. Hal McKenzie, WR-ALC Public Affairs

## Munitions section keeps warfighters battle ready

Building 3812 is an island of industry for Tinker Air Force Base, Okla. The eight-person shop can make all the difference for a military aviator when he or she is over hostile territory and the aircraft can't be saved ... but the flyer can.

Explosive charges shoot sections of aircraft out of harm's way when pilots have to eject in a hurry. The 72nd Air Base Wing Supply, Munitions Section not only protects, but also inspects these charges for a host of on-base and transient customers at Tinker.

During the Gulf War, the munitions section was the hub for aircraft munitions, meeting the explosive needs of the warfighter. Their tempo may have slowed down since then, but their function hasn't changed. Today, the section manages 44 accounts for a variety of military and government organizations.

"We provide munitions for all aspects of the base," said Tech. Sgt. Thomas Gonsor, noncommissioned officer-in-charge of munitions materials. "That includes the 552nd Air Control Wing, the 72nd Security Forces Squadron, the 3rd Combat Communications Group, area reserve units and Navy units. We're also involved in a lot of the Air Logistic Center's maintenance operations. We maintain everything from high explosives down to a firecracker."

The munitions section issues cartridge and propellant-actuated devices and other charges to remove the hatches from the B-1B and B-52 aircraft so pilots can eject in an emergency. Tech. Sgt. Scott Hodge, NCOIC munitions operations, said the B-1B depot maintenance operation keeps the munitions section busy.

"The depot strips the aircraft down here," Sgt. Gonsor said. "It can take up to three hours to remove the explosives from a single aircraft because there are several hundred such items."

Munitions technicians are trained to supply their equipment within a short time frame and B-1B depot work tests that ability. An added concern for technicians is that most explosives used in the B-1B, and for similar purposes in other aircraft, have a service life. After that, they can become unstable and present additional problems to crew and maintainer alike. Technicians inspect the explosives to catch these problems and can recycle the explosive or destroy them if they are too unstable.

Both Sgts. Gonsor and Hodge describe everyday operations in Bldg. 3812 as being "on an island." The remoteness of their facility is an important safety issue and specially designed buildings with 2-to-3-foot thick walls protect the people outside as much as they do the munitions inside. Certification and training are big parts of the everyday munitions operation and the job can be stressful at times, the technicians said. Knowing the dangers around them and how to respond eliminates the worry.

The typical studies of a munitions technician include inspection guidelines, Air Force policies and standards and chemical breakdowns of explosives, to name a few.

Sgt. Hodge foresees advances in munitions use in the next century. In the 1950s and '60s, carpet-bombing campaigns in Southeast Asia required hundreds of bombs. Today, one bomb can accomplish the same task with less risk to the warfighter.

According to Sgt. Hodge, precision and fire-and-forget technology advances further every day.

"Munitions are a big part of the Air Force," said Sgt. Gonsor. "Loaders put the bombs on the plane and the pilots may drop them, but we're the ones, out there building stuff up in 20-degree below weather or when it's 140 degrees on the ramp. We're a small unit, but we get the job done."

— Mr. Andy Stephens, OC-ALC Public Affairs



# Tinker gears up to meet demands

The mission at Tinker Air Force Base, Okla., as a depot maintenance center is to provide the customer with the product they need in the most timely and cost effective manner. That is exactly what Team Tinker has done by manufacturing ratchet gears for 161 grounded C/KC-135s.

In February, Air Mobility Command announced the stand down of 161 in-service C/KC-135s as a precautionary measure for a potential stabilizer trim actuator problem. The STA controls the horizontal stabilizer, the small wings at the tail of the aircraft, which allows the pilot to move the aircraft up or down. Engineers discovered a problem in the rework process of the gear, an internal component of the STA. Failure of this gear could result in a jammed stabilizer making it difficult for the pilot to control altitude.

Several contractors were solicited to quickly manufacture new gears. The quickest delivery would be six months. This was unacceptable; so Tinker stepped up to get the planes flying.

Tinker had the equipment needed to make the new ratchet gears, but the required type of stainless steel for the ratchet gear was not available in the correct size.

"The material available on the shelf was 6.5 inches in diameter when actually 4-inch material would have been ideal to make this part out of," said Mr. George Reed, production division, manufacture and repair section chief. Since airplanes were grounded, we had to take what was available."

After the steel arrived at Tinker, approximately 50 employees from the commodities management, propulsion management and logistics management directorates volunteered to transfer to swing shift or work the required overtime to support the 24-hour-a-day, seven-day-a-week shift requirement to manufacture the part. They worked these shifts for the first three weeks of production.

Before production could begin, planners had to figure out an efficient process. The process includes machining, plating, heat treating, shot peening, grinding and many other steps. "The customer, in this case Defense Logistics Agency, sends us the work order, which authorizes us to manufacture the part," said Mr. Dell Shaw, project planner. "From that, we lay out each step of the process and develop the work control document that machinists and others use on the floor. This document outlines the involvement of each shop and defines specific processes, specifications, tolerances, and inspection procedures for each of the steps."

Each step in this process was strategically planned and carefully carried out. The first step in the process was to mill or cut the metal to the required size. This process took place in the numerical control machine shop where the machines were programmed to remove the excess material and get the part "near net shape." Mr. Alan Casey, shop supervisor, said, "Our normal production runs are one or two

— Continued on page 22



*Top: Mr. Steve Morely, a machinist in the precision grinding unit, positions a gear before grinding the internal diameter. Bottom: The radial finish, a change directed by Boeing and developed by Tinker's Mr. David Gatlin, helps the braking action of the gear. (Photos by Ms. Margo Wright)*

# Sheet metal press forms complex shapes

**C**astor oil is known as a repugnant old-fashioned stomach remedy, but the Technology and Industrial Support Directorate at Robins Air Force Base, Ga., has found a less distasteful use for it in its fluid cell press.

"The press has unique capabilities," said Mr. J.J. McClure, sheet metal manufacturing section chief. Unlike conventional stamp-and-die presses, it uses a rubber bladder filled with castor oil to force sheet metal at 20,000 pounds per square inch over a shaping tool to form complex shapes in one operation.

The all-natural fluid, derived from the castor bean, does not react with the rubber bladder and is friendly to the environment. It enables the press to fill "every nook and cranny" of the part to be shaped, said Mr. Chris Barkley, manufacturing engineer.

"Weighing 353 tons, the press is also unique in size," he said. "The process is not peculiar, but what's unusual is our machine's size. It's the largest in North America, and the largest one used in the aerospace industry."

According to the directorate, the press can handle aluminum, titanium, stainless steel, roll steel and magnesium from .008 inches to .375 inches. The process reduces secondary work, like sanding and hammering out wrinkles, that other presses require.

The press has two trays, one on each end. One press can handle forms up to 14 inches deep. The trays' large size can handle multiple parts at one time and one tray can be forming while the other is loading.

It reduces overall production time by 20 percent, actual forming time by 40 percent, cuts manpower by 17 percent and allows production of 25,000 additional parts per year at higher quality, saving time and money for the customer, according to the directorate.

— Mr. Hal McKenzie, WR-ALC Public Affairs



*Mr. Ricky Churchwell, fluid cell press operator, places a piece of aluminum on a mold. A castor oil-filled bladder will then roll over the metal and create a formed piece. (Photo by Ms. Sue Sapp)*

## Continued from page 21

parts at a time to support our repair line stoppages, but getting a big order is what these machines are designed to do."

Next, in the general machine shop, a milling machine is used to cut the "teeth" into the ratchet gear. Each one is milled to precise measurements programmed for this particular job. The gear is then chrome plated and in the Precision Grinding Shop, they finish grinding the chrome to the proper thickness.

Mr. Steve Morley, precision grinding shop machinist, volunteered to work 6 p.m. to 6 a.m. "It was a nice feeling knowing that what we were doing was really important," he said. "A lot of times we don't get to see that, we just have a customer that needs a part and that's all we hear. This one actually grounded some aircraft and it was satisfying knowing that what we were doing was mission essential."

The final grinding roughs the surface of the gear to provide breaking action on the STA system. During this entire process, the gears are heat-treated a total of four times to get the proper strength and hardness of the metal. The final plating of this gear is performed off base, and then the gears are run through a

final inspection at Tinker before release.

"This project was on the front burner. We were looking at it every step of the way until it was delivered to the customer," said Mr. Rick Bishop, material chief, logistics management. Tinker's readiness and adaptability proved to meet the customers need once again. Mr. Reed said, "This is another reason why we need to beat home why we need depots. We'll stop everything else and work 24 hours around the clock to get that job done."

When the initial order was placed for Tinker to make this gear, the delivery date of the first batch was April 14. Tinker employees saw the need, rose to the occasion and put the mission first. As a result of their dedication and hard work, the first shipment of gears was delivered March 17, almost a month ahead of schedule. The gears were installed in STA assemblies and by May 5 all 161 previously grounded KC-135 aircraft were back in the air.

Tinker's employees played a part in putting those planes back in the air. It's plain to see that when a job, no matter how big, needs to be done, Team Tinker stands ready to do the job.

— Ms. Rhonda Nichols-Lugo, OC-ALC Public Affairs



# New Air Force Flight Test Center Museum opens

The new Air Force Flight Test Center Museum at Edwards Air Force Base, Calif., opened July 21 with ceremonies featuring distinguished figures in flight test history, including retired Brig. Gen. Chuck Yeager.

The 12,000-square-foot facility replaced a much smaller temporary museum and is co-located with aircraft displays highlighting Edwards' flight test history. It boasts a theater and library where visitors can research history, as well as climate-controlled storage and work areas for restoration projects.

In fact, there is so much to see at the new facility that even 12,000 square feet isn't enough space, said Mr. Doug Nelson, museum director. Exhibits will need to be rotated.

"The idea is to keep it fresh," he said. "Our mandate is preserving and displaying the history of Edwards, its antecedents and Air Force Flight Test Center."

The new museum and airpark offer a look at many of the center's accomplishments, showcasing exhibits on such diverse subjects as formation of ancient lakebeds, early homesteading, the first military uses of Edwards, flight testing during World War II, high-speed flight and the story of Capt. Glen Edwards, for whom the base was named. Other exhibits include displays of aircraft propulsion systems, hardware, life support equipment, technical drawings, test reports, memorabilia, photographs, rocket engines and models.

Future exhibits will highlight how Edwards' history ties into the ever-evolving role of the warfighter.

Mr. Nelson noted exhibits like these don't just happen overnight; it was the efforts of many people making this endeavor possible. More than 60 volunteers put in roughly 1,500 hours preparing the facility for its opening.

The museum's importance is more than just preserving a piece of the past, he said. "We've heard the phrase 'to prepare



*Transient alert crews and 412th Test Squadron members ease an NF-4C aircraft around a corner as they tow it to its new home at the Air Force Flight Test Center Museum. (Photo by Mr. Doug Nelson, AFFTC)*

for the future we should learn from the past,' and there's never been enough done to preserve the history of installations. For many years, there wasn't a great deal of interest in preserving Edwards' history. Here, the idea of preservation began in the '70s with aircraft placed on pedestals, and so started the interest in preserving the material history.

"The museum is an excellent way to show the public why we're so important," the curator added. "The better you are at telling your story, the better you are at telling the world how good you are and the more support you gain from the public."

To Mr. Nelson, the AFFTC Museum is not just a place where old aircraft and militaria are kept and preserved. It is an encounter with Edwards' past and a revelation of its accomplishments to the global community. "History is the timeline of progress," he said. "We owe it to ourselves and our children to take a moment to reflect on what was, so we can work together toward what will be."

For information on museum hours and gaining access to the base, call the AFFTC Museum staff at (661) 277-8050 or send e-mail to [musuem@edwards.af.mil](mailto:musuem@edwards.af.mil). The museum's address is AFFTC Museum, 95 ABW/MU, 405 S. Rosamond Blvd., Edwards AFB, CA, 93524.

— AFFTC Public Affairs report



**Air Force recruiting and retention numbers rose by 72 Aug. 4 as 61 new recruits and 11 re-enlistees raised their right hands at the Air Force Museum, Wright-Patterson Air Force Base, Ohio. Gen. Lester Lyles, AFMC commander, administered the oath.**



# Brooks mother's loss prompts book on coping with an infant's death

When her four-day-old first-born son died in her arms, neither Ms. Jan Rosales or any other family member believed the tragedy would become a blessing in disguise. What has transpired in the ten years since Joseph Michael Rosales' death is a first-of-its-kind guide to grieving parents who have lost newborns.

*Given in Love But Not Mine to Keep* is as much a mother's journey through grief and acceptance as it is a book about hope for parents who, as the subtitle suggests, find strength in the loss of a newborn child. What prompted the wife of U.S. Air Force School of Aerospace Medicine entomologist Capt. Armando Rosales to write and publish her first book is based on a need to create a therapeutic tool for herself and others.

### Coping with grief

"I searched for books that could help me cope with grief," she said. "I asked myself, 'how did other people deal with this kind of loss?' I found nothing in print on coping with newborn death that also talked about God. I thought there was such a void here." Ms. Rosales recalls.

A committed Christian, she soon learned how many others had experienced the loss of a child. "People came out of the woodwork. They told me about still-born births and the death of infants soon after birth. I found that people just don't talk about the loss of infant children when asked in conversation, 'How many children do you have?'" she noted. The perpetual silence displayed by parents whose children had died in infancy convinced her.

She said, "I can't deny the existence of my son. I feel like I have three children," referring to daughters Nina and Emma.

Attending family support group meetings did not interest Ms. Rosales following the loss of her son. "I was struggling with issues of faith and trust and why God allowed this to happen to us," she confessed. She had no intention of writing a book in the years following Joe's passage on March 4, 1990. What she did do was characteristic of her lifelong practice of keeping a journal.

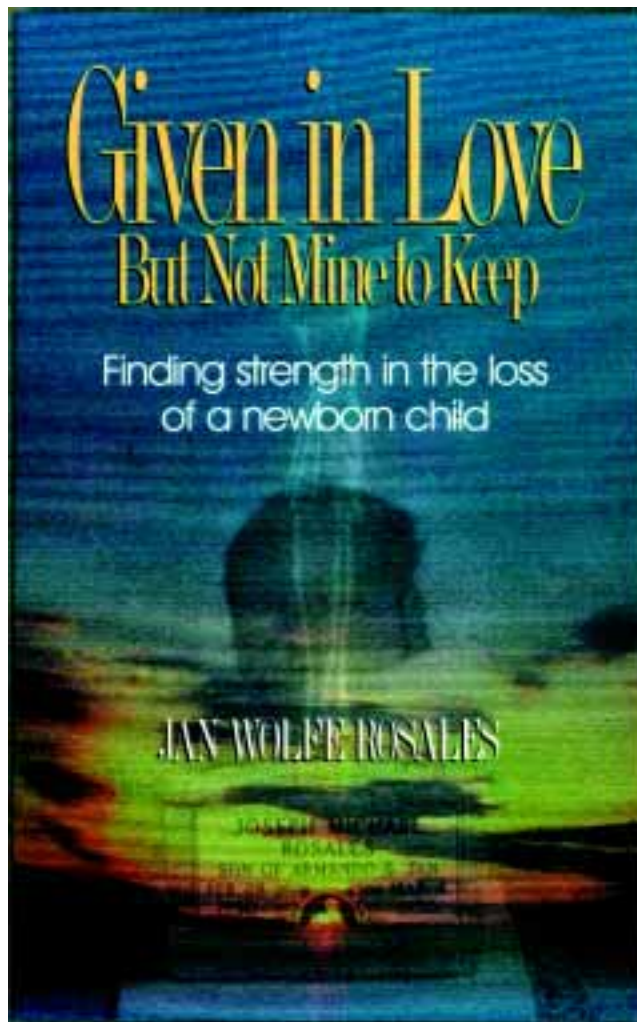
### Day-to-day chronicle

"I started writing my inner thoughts, chronicling day-to-day what had happened," she said. "The days surrounding Joe's death were a blur. I knew time would erode that memory if I had not preserved it. That's all I had left of Joe."

Her first step in healing began with her initial journal entry, which also is the opening in her book: "*April 1990 – my baby has died. I wonder if the pain I feel in my heart will ever stop. Somehow, I don't think it will.*"

For six years Ms. Rosales wrote profoundly eloquent prose that conveyed in clear, simple language a woman's struggle to cope with the loss while trying to maintain and develop her relationship with God. "After eight years, I felt I had something that was presentable, then I asked myself, 'what qualifies me to write a book?' I realized that if I'm feeling a need, then others are too. I felt perhaps that the book was Joe's purpose."

After many failures to secure a publisher, Ms. Rosales found a literary agent who eventually negotiated a contract with



Baltimore-based publisher Erica House. The book was released nationally May 1st, and can be ordered via the Internet through Amazon.com.

### A new beginning

"The book has helped me in the grieving process. I experienced personal growth in writing it, often feeling that much of the time I was guided by the Lord," she said. "I realize now that it was part of God's perfect plan."

She considers the publication of her book a new beginning to the rest of her life. At the core of her many blessings is her devotion to her husband who she describes in her book "truly the love of my life."

"I have talked with women who have lost a child, who later lost a spouse. There are two distinctly different types of grief associated with the loss of a child and spouse. I think losing a spouse would be much more difficult," she admits.

— Mr. Rudy Purificato, 311<sup>th</sup> HSW

# Edwards captain bound for France

Some might say five and a half years in the desert is a drought. But for one aspiring bluesuiter, it's led to a wellspring of opportunity and the career-broadening experience of a lifetime.

Capt. Angie Wallace, F-117A special projects flight commander for the 410th Flight Test Squadron, Edwards Air Force Base, Calif., has earned an Olmsted Foundation scholarship to attend school in a foreign country. She will find her next duty station quite different — Lyon, France — as she shifts from studies of low observable and avionics flight tests to graduate work in political science and international relations. She will attend the University of Lyon on a two-year grant provided by the foundation.

"First of all, I feel blessed. It's been whirlwind ... it's incredible," Capt. Wallace said. "It's going to change my life. Whereas my Air Force career up to this point has been deep in engineering, this will be very career-broadening."

Capt. Wallace, one of three Air Force officers to be selected for the Olmsted Scholar Program this year, will join the ranks of nearly 325 servicemembers who have gone before her studying 27 languages at 116 different foreign universities in 40 foreign countries.

Fundamental to the program is a conviction that leaders must be educated broadly. That vision of education — in the hope of the program's founder, retired Army Maj. Gen. George Olmsted — surpasses the bounds of the classroom. In Capt. Wallace's case, the assignment will embrace the institutions, characteristics and customs of the people and region of Lyon.

From a corner cafe to the fluctuating hush and roar of Lyon's annual grand prix of tennis, she will be saturated in an experience that could shape the rest of her career and, perhaps, her life.

Capt. Wallace will return from France with a four-year active-duty service commitment, as well as an opportunity to spend an additional year at an American university completing requirements for a master's

in political science and international relations.

The daughter of a native-born German mother, she learned German at home at an early age and continued studying it through college. It was through her German instructor at the U.S. Air Force Academy that she first learned of the Olmsted Scholar Program.

Nearly 10 year later, following an application and nomination process begun nearly a year ago, she'll head up the California coast to the Defense Language Institute in Monterey, Calif., to undergo intense language training before departing for France in April of 2001.

As for other opportunities after studying abroad, Capt. Wallace said she hopes to return and teach aeronautical engineering and French at the Air Force Academy, and then possibly "...work at an embassy or in the Pentagon doing something that combines my engineering and French skills."

— 2nd Lt. Cris L'Esperance, AFFTC Public Affairs



*Capt. Angie Wallace, will be heading off to the Defense Language Institute in California to undergo intense language training before departing for France in 2001.*

## Lieutenant earns place in history

"Brilliant" was one expert's summation of the young Robins Air Force Base architect who worked hard and slept little as part of a 10-person design team virtually cloistered in a castle-like structure on the grounds of the National Cathedral in Washington, D.C.

When 2nd Lt. Shelley Hoenle, an architect with the 78th Civil Engineer Group, earned a place on the 10-person team in worldwide competition, she earned a place in history. The team's project is the first privately funded monument celebrating America's history. Sponsored by the Millennium Gate Foundation, the competition inspired entries from about 100 young professionals and students who received degrees in architecture or related fields since 1996.

Foundation Chairman Mr. Rodney Cook, Jr., who described

Lt. Hoenle as "brilliant," said she has been doing "an excellent job" incorporating her ideas into the final design for Washington's Millennium Gate.

The team worked until 5 in the morning July 6, the day before its design was to be finalized. The task began July 3, the start of what architects refer to as a charette — an intensive effort architectural students make to complete solutions to architectural problems. Lt. Hoenle received \$1,000, the expenses-paid trip to Washington and the privilege of being credited as a co-designer of the Millennium Gate.

The first-place design, which earned \$1,500, was the team's starting point, but the final design incorporated the best ideas of the entire team.

— Reported by Mr. Chris Zdrakas, 78th ABW Public Affairs



### Security specialist receives DOD Antiterrorism Award

WRIGHT-PATTERSON AIR FORCE BASE, Ohio — An Air Force Research Laboratory security specialist recently received the Defense Department's Outstanding Antiterrorism-Force Protection Innovation or Action Award for an individual at the Air Force level.

Tech. Sgt. Ronald Lambert, who works at AFRL's Human Effectiveness Directorate research site in Mesa, Ariz., received the award from the assistant secretary of defense for special operations and low intensity conflict recognizing his significant achievements in the antiterrorism field.

Before the award nomination, Sgt. Lambert initiated numerous security measures including: posting creative security awareness posters throughout the installation; spearheading research for security forces using night vision devices by developing the first-ever night vision training course designed for security forces; and grooming the installation to decrease suspicious activity.

He also used the intranet site to provide on-demand training and tips to all installation personnel.

In addition, Sgt. Lambert helped organize a Joint Counterterrorism Team training exercise. More than 300 people conducted and participated in the exercise that involved 10 local, state and federal agencies and response teams.

Emergency response exercises like this have helped to build a strong rapport between the Mesa Police Department and AFRL, said Col. Jerald Straw, Mesa research site commander. As a result of his security credibility, other organizations routinely consult him on protective measures, such as Mylar installation, training and facility improvements.

— Reported by Mr. Timothy Anderl, AFRL/PA

### Arnold civilian earns Air Force recognition

ARNOLD AIR FORCE BASE, Tenn. — Arnold's deputy environmental management division chief has been named the Air Force Association's Civilian Program Manager of the Year.

Mr. Clark Brandon spearheaded the

effort to reduce hazardous materiel-related Environmental Compliance Assessment Management Program findings by 78 percent from calendar year 1997 to earn the award. Under his direction, the base achieved zero notices of violation for air and water compliance programs from 1995 to present.

"I am overwhelmed, humbled and blessed by God," Mr. Brandon said. "I know there are many people who have contributed to my life and own a piece of this award."

Mr. Brandon's nomination package cited his completing two innovative landfill cap construction projects totaling 121 acres and costing \$1.5 million less than the original estimate. He secured funding to eliminate 168 polychlorinated biphenyl, or PCBs, transformer bushings, making Arnold PCB free.

Mr. Brandon has been instrumental in obtaining funding for modifying Arnold's cooling water and wastewater system, according to statements in his nomination package. He personally interceded with state regulators and negotiated a test cell heater air permit modification, and prevented test delay and significant programmatic impact to F-22 Raptor, Joint Strike Fighter and the F/A-18 Super Hornet.

Mr. Brandon said, "The folks I work with on a daily basis encourage me to excel, to take risks, to find new ways for old processes and to find joy in the journey along the way. The leadership inspires me for they have vision, courage, passion and are not constrained by reality."

Mr. Brandon also developed a working partnership with the Nature Conservancy for research, development and protection of unique, natural resources within the boundaries of Arnold.

"I think all relationships require effort and it is critical to know all about the people and organization. I've spent countless hours communicating and seeking to understand so the Arnold headquarters, federal, state and local relationships are kept in excellent condition," said Mr. Brandon. "Mr. Bill Dunne told me long ago, 'you will not be remembered for wise and great decisions but how you cared for people.'"

In 1999, Mr. Brandon was honored with the Exemplary Civilian Service Award, Special Act and Service Award

and the AEDC Team Excellence Award.

"Throughout this year, Mr. Brandon has performed in an exceptionally superior manner providing program management leadership in the critical area of environmental management."

— Reported by 2nd Lt. Tisha David, AEDC/PA

### Poirier recognized for professionalism

EGLIN AIR FORCE BASE, Fla. — Capt. William J. Poirier, 96th Communications Group, is a recent recipient of the Air Force's Communication and Information Professionalism Award. Capt. Poirier played an integral role in supporting five operational wings at Eglin by leading a demanding operation of 59 military, civilians and contractors. He controlled maintenance of a \$354 million Air Traffic Control and Landing system that managed 86,000 air operations.

Capt. Poirier led an Air Force tiger team that provided Air Staff a solution to the Air Force firewall program that was laden with software bugs. He created the first-ever firewall training plans and operations checklists.

He currently is leading a new team to fix operations shortfalls with Defense Message Systems, again for Air Staff. Capt. Poirier was hand-picked to lead a \$65 million Kirtland AFB, N.M., communication squadron outsourcing evaluation effort.

— Reported by Ms. Lois Walsh, AAC/PA

### Air Force civilian recognized for valor

MCCLELLAN AIR FORCE BASE, Calif. — An electrical flight chief with the 77th Civil Engineer Division here saved a man's life recently and received the Air Force Civilian Award for Valor to recognize his bravery.

Mr. Kenneth Davis received the award from Gen. Lester Lyles, Air Force Materiel Command commander at McClellan's Building 1. Mr. Davis received a pin-on medal, certificate and \$500 cash award for his efforts.

The Air Force Civilian Award for Valor is a mirror of the military Airman's Medal, which recognizes those who voluntarily risk their individual safety beyond the call of duty, said Mr. Rick Crawford, AFMC Military awards and decorations manager.



"I could count on one hand the number of these awards we've approved during the past year," said Mr. Crawford. "It's a very coveted award and the person who receives it has to be very deserving."

Mr. Davis responded to an electrical explosion in McClellan's commissary Oct. 25. Mr. John Callahan, a Sacramento Municipal Utility District electrician, approached Mr. Davis, asking him to help with a problem in the mechanical room on the commissary's west side.

Seeing the temporary wiring the weekend technician had installed, Mr. Callahan began evaluating what corrective action was required to return the system to normal operation. Mr. Davis, who was approximately 5 feet from Mr. Callahan, was looking at a piece of associated equipment when he heard an explosion and saw a bright flash of light.

"It was all reaction," said Mr. Davis. "Inside this room was a fire ball. When I first opened my eyes I couldn't see a thing, so I shut them again. All I could hear was him (Mr Callahan) yelling, 'I'm on fire'. So I dropped to my knees and when I could see again, I made my

way over to him."

Calling on his years of experience, Mr. Davis realized that the panel Mr. Callahan was working on had "flashed," and he immediately rushed to his side, putting out the flames that were engulfing his shirt. The room was rapidly filling with dense black smoke; Mr. Davis put Mr. Callahan's arm over his shoulder and kicked open the mechanical room doors, dragging him to safety.

Mr. Davis knew Mr. Callahan needed immediate medical attention, so he directed several commissary personnel in the area to call 911 and bring him water, ice and clean rags.

Mr. Davis said he was not looking for recognition when he took his heroic actions, but the award has humbled him. Overall he wishes this were something he didn't have to do; however, he did what he needed to save Mr. Callahan.

Mr. Davis' actions, based on years of training in the electrical field, sound common sense, and his desire to help a fallen comrade, culminated in a successful rescue.

"Mr. Davis' quick thinking and courage reflects the highest devotion to duty and a great credit upon him and the

Air Force," said his supervisor Mr. Jim Olsen, facility preservation and transfer branch chief.

— *Reported by Ms. Robin Jackson, SA-ALC/PA*

## Cook stirs up award

KIRTLAND AIR FORCE BASE, N.M. — A 377th Air Base Wing Services Squadron cook recently earned the 1999 Air Force Services Award in the military technician category.

Staff Sgt. Adam Hernandez, currently serving as a security forces augmentee, is credited with significant savings for his squadron and accuracy in his job performance. He also is recognized for mentoring, serving as his squadron's co-project officer for Combined Federal Campaign, volunteering and receiving the John L. Levitow Award from the Airman Leadership School commandant.

Lt. Col. Richard Gravette, 377th ABW Services commander, called him a "true leader," "superb," "a polished mentor" and "a proven performer."

— *Kirtland Public Affairs report*

## Edwards firefighters blaze through regional finals

A firefighter team from Edwards Air Force Base, Calif., is going to Las Vegas in November after qualifying for the Firefighter Challenge World Championship.

The squad was invited to Las Vegas after completing an obstacle course, in five-man teams, in less than two minutes during a regional event hosted by the International Association of Fire Fighters. Team A took first place during the Irvine, Calif., contest with a time of 1:33.16. Team B was close behind with a time of 1:53.29.

"It feels good to win," said firefighter Mr. Sam Billington, Team A captain. "Showcasing the Edwards fire department to the public and other departments means a lot to us. All the hard work paid off."

For the competition, the squads found themselves racing upstairs and downstairs, literally. After an alarm sounded, the first team member carried a fire hose up five flights of tower stairs. A fireman at the top handed off a flashlight to a second member, who pulled another bundle of hose from the ground to the top of the tower. Once that was completed, the second participant rushed down the stairs and handed the flashlight off to firefighter number three.

This part of the obstacle course involved a Keiser force machine. The third team member used a 9-pound sledgheam-

mer to knock back a 165-pound I-beam.

When done, the fireman raced the flashlight through a weave of fire hydrants to team member four, who strapped a fire hose over his shoulder before racing to a target. Once through a mock-up door, the firefighter unleashed a powerful stream of water at a target.

After hitting the target, the fourth competitor gave his last teammate the flashlight. For the last obstacle in the course, the fifth firefighter lifted and dragged a 185-pound dummy 100 feet to the finish line. To prepare for such a strenuous challenge, the Edwards teams practiced for three months at various fire stations.

"This is something that you must prepare for and train for months in advance," Mr. Billington said. "Practicing basic firefighting skills as much as possible is essential."

Five of this year's 10-man team were on the Edwards team that placed 18th in the world 1999 championship event

— *Reported by Senior Airman Dean Witt, AFFTC/PA*



# Titan IV

